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ABSTRACT

This study compared the relative effectiveness of the new University of Illinois Committee on School Mathematics (UICSM) "Stretchers and Shrinkers" and "Motion Geometry", mathematics materials with traditional mathematics materials in improving arithmetic ability of underachievers. Data on arithmetic computation, concepts, and application of random samples of seventh and eighth grade students at one junior high school were obtained and analyzed. The "t" test was used to determine possible significant differences between the control group, which used traditional materials, and the experimental group, which used the UICSM materials. The findings showed that for seventh grade students there were no significant differences. However, for eighth grade students there were significant differences favoring students using the "Motion Geometry" materials. (Author/MM)

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ABSTRACT

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Two recently developed University of Illinois mathematics courses for underachievers, Stretchers and Shrinkers and Motion Geometry, have been adopted for use by many school districts throughout the United States. Many teachers have been trained at NSF funded institutes to teach these seventh and eighth grade courses. Not only is this type of training expensive to the federal government, but newly adopted materials of this type cause a considerable financial outlay to the adopting school district. Many districts are now being held accountable for expenditure of funds and increasingly are being required to show that new materials are superior to traditional materials being replaced.

The University of Illinois Committee on School Mathematics (UICSM) has indicated that they feel that the mathematics ability of students taking their courses will improve more than the ability of students studying other mathematics courses. However, very little objective evidence has been presented to justify this assertion.

In order to gather data on the effectiveness of these UICSM mathematics courses, an experiment was conducted during the 1970-71 school year at a Nevada junior high school.

Prior to the 1970-71 school year, students who were considered low achievers by their principal, counselor and teachers were randomly placed into experimental and control groups. Seventh grade students in the experimental group used the Stretchers and Shrinkers materials while students in the control group used traditional mathematics materials that had been in use at the school for the past three years. Eighth grade students in the experimental group used the Motion Geometry materials while students in the control group used traditional mathematics materials that had been in use at the school for the past three years.

A teacher who had been trained in use of the UICSM materials taught both the seventh grade experimental and control groups and the eighth grade experimental group. A teacher who was rated "outstanding" by the school administration and whose experience approximated that of the eighth grade experimental group teacher taught the control group.

The hypotheses tested by this experiment were:

1. There is no significant difference in mean gain in mathematics ability of seventh grade students receiving instruction from the Stretchers and Shrinkers materials of UICSM and those receiving instruction from traditional materials as measured by the Stanford Achievement Test.

2. There is no significant difference in mean gain in mathematics ability of eighth grade students receiving instruction from the Motion Geometry materials of UICSM and those receiving instruction from traditional materials as measured by the Stanford Achievement Test.

In order to test these hypotheses, the Stanford Achievement Test, Advance Battery, Form W, mathematical subtests in arithmetic computation, arithmetic concepts and arithmetic application and a mental ability test were given as pre tests to all groups. The Stanford Achievement Test was given again in May 1971, as a post test.

The t test was used to determine whether or not any significant difference existed.

Table A below shows pre test data and t values obtained from this data.

From this data it can be seen that no significant differences exist Hence it can be inferred that randomization was successful.

TABLE A

Comparison between Pre Test Raw Scores of
experimental (E) class and Control (C) class

Seventh Grade

	IQ		Arithmetic Computation		Arithmetic Concepts		Arithmetic Application	
	E	C	E	C	E	C	E	C
N	30	29	30	29	30	29	30	29
$\bar{X}$	92.0	95.0	7.5	7.8	8.[illegible]	[illegible]	8.6	9.2
t	.758		.427		1.71		.630	
t req. at .01 level	2.45[illegible]		2.457		2.457		2.457	
Sign at .01 level	[illegible]		[illegible]		n.s.		[illegible]	

Eighth Grade

	IQ		Arithmetic Computation		Arithmetic Concepts		Arithmetic Application	
N	29	29	29	29	28	29	29	29
$\bar{X}$	92.0	94.0	[illegible].9	9.6	13.0	12.3	10.5	10.2
t	.92		[illegible].05		.594		.325	
t req. at .01 level	2.482		2.482		2.482		2.482	
Sign at .01 level	n.s.		n.s.		n.s.		n.s.	

Table B below shows post test data and t values obtained from this data.

TABLE B

t Test for Raw Score Gain between September and May tests with the Experimental (E) classes and Control (C) classes of both 7th and 8th grades on the three Stanford Achievement Arithmetic Subtests (Advanced Batteries)

Seventh Grade - Stretchers and Shrinkers

	Arithmetic Computation		Arithmetic Concepts		Arithmetic Application		Total Raw Score Gain	
	E	C	E	C	E	C	E	C
N	[illegible]	26	29	[illegible]6	28	2[illegible]	29	26
$\bar{X}$	3.5[illegible]	4.07	3.7[illegible]	3.00	2.28	2.6[illegible]	9.77	9.61
t	.42[illegible]		.77[illegible]		.608		.048	
Sign at .01 level	n.s.		n.s.		n.s.		n.s.	

Eighth Grade - Motion Geometry

	Arithmetic Computation		Arithmetic Concepts		Arithmetic Application		Total Raw Score Gain	
	E	C	E	C	E	C	E	C
N	28	27	27	26	27	26	27	27
$\bar{X}$	4.57	3.07	[illegible].89	3.23	4.04	1.54	14.22	7.55
t	1.1		.59		2.74		2.96	
Sign at .01 level	n.s.		n.s.		sign		sign	

From the data it can be seen that significant differences exist at the eighth grade level in both arithmetic application and total raw score gain. Hence the null hypothesis must be rejected. No significant differences exist at the seventh grade level at the .01 level of significance. Hence the null hypothesis must be accepted for seventh grade mathematics achievement.

Even though the experiment was conducted in only one Nevada junior high school and involved only two teachers and 130 students, it might be possible to hazard a few inferences. In this experiment students studying Stretchers and Shrinkers did as well as those studying traditional mathematics as measured by a traditional test. Hence it might be implied that students studying Stretchers and Shrinkers materials learn just as much arithmetic as students studying more traditional materials.

Generalizations at the eighth grade level are more hazardous because the teacher variable may not have been completely controlled. However, in this experiment students studying Motion Geometry did do significantly better in the areas of arithmetic application and total score than students studying traditional materials. At first this result might seem surprising. However, this might be explained by considering geometry to be an "application" of arithmetic or by the fact that Motion Geometry includes a significant amount of arithmetic. From the eighth grade experiment it can be implied that students using the Motion Geometry materials in this setting learned significantly more arithmetic than students using traditional materials.

In addition to the main experimental data gathered, students in the experimental group who used the UICSM materials responded to three questions as indicated in lable C below.

TABLE C

Experimental Group's Response to Questionnaire on selected items.

Question 1: Do you feel that the new math that you studied this year was easier or harder than mathematics that you studied last year?

	7th Grade		8th Grade	
	N	%	N	%
Harder	5	20	3	11
Easier	13	52	16	62
Both	7	28	7	27
Don't know	0		0	.
No Response	0		0	
	25	100%	26	100%

Table C Cont'd.

Question 2: Do you feel that the new math instruction that you received this year will make next year's work in math easier, harder or the same?

	7th Grade N	7th Grade %	8th Grade N	8th Grade %
Harder	7	28	4	15
Easier	14	56	12	46
The Same	4	16	7	27
Don't Know	1	4	1	4
No Response	0		2	8
	26	100%	26	100%

Question 3: Do you feel that the new math you studied this year was better, worse or the same as the math that you studied last year?

	7th Grade N	7th Grade %	8th Grade N	8th Grade %
Better	20	80	20	77
Worse	4	16	4	15
The Same	1	4	1	4
No Response	0		1	4
	25	100%	26	100%

The questionnaire was administered in May near the end of the course. From this data, it may be inferred from the favorable student feelings toward the UICSM materials that the experimental group had positive attitudes toward the materials and believed that they would do even better in mathematics next year.

Although not part of the main experiment, it was determined that students studying Motion Geometry gained more than one year in achievement and that those studying traditional materials gained less than one year, as shown in Table D below.

TABLE D

Data on Net Gain of Average Grade Equivalents, eighth grade Control and Experimental groups between September and May testing on the three math Subtests.

	Control Group	Experimental Group
	Total GE Gain Sept.-May (yrs.)	Total GE Gain Sept.-May (yrs.)
Arithmetic Computation	+.78	+1.29
Arithmetic Concept	+.85	+1.14
Arithmetic Application	+.57	+1.14

A tentative overall conclusion of this experiment might be that students using the UICSM materials have favorable attitudes toward the materials and make satisfactory progress in improving their arithmetic abilities.

The tangible and intangible results of this experiment have caused the Nevada junior high school involved in this experiment to adopt the University of Illinois materials for use with underachievers in their school. Even though the amount of objective evidence involved in this school's decision was minimal, it is probably more than the amount of data and evidence utilized in most curriculum decisions.

The main implication of the study is that further study is necessary in order to evaluate the effectiveness of these courses. A larger well controlled study involving more students, schools and teachers is needed.

During academic year 1971-72 a study of UICSM mathematics involving all Nevada junior high schools will be conducted by one of the authors. Participants who attended a University of Nevada Resource Personnel Workshop and who are currently teaching Stretchers and Shrinkers and/or Motion Geometry will serve as the experimental group and other Nevada junior high school teachers

who have not attended a UICSM workshop will serve as the control group. The purpose of the study will be to determine which groups attain greater understanding of mathematics concepts and principles, and which groups have more positive attitudes toward mathematics and self.

In order to make the results even more generalizable, the University of Nevada hopes to conduct a Resource Personnel Workshop in UICSM Mathematics during the summer of 1972 for teachers in the Rocky Mountain and Pacific Coast states and to conduct a similar experiment in 1972-73 utilizing these participants and their students as an experimental group. It is felt that this experiment will be one of the most comprehensive and complete studies done on new mathematics curriculum and should provide useful information for administrators and teachers contemplating adoption of the UICSM materials.